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Attorney for Appellant

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PATENT
Docket No. SJ0920010058US1

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant:	Tsann Lin et al.	)
Serial No.:	10/066,835	) Group Art
Filed:	February 4, 2002	) Unit: 1773
For:	***IN-SITU* OXIDIZED FILMS FOR USE AS GAP LAYERS FOR A SPIN-VALVE SENSOR AND METHODS OF MANUFACTURE**	)

Examiner: Kevin M. Bernatz

APPELLANT'S APPEAL BRIEF

Commissioner for Patents and Trademarks
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

On November 3, 2003, Appellant filed a timely Notice of Appeal from the Final Office Action mailed August 1, 2003. With this appeal, Appellant is filing a request for reconsideration that includes an affidavit and exhibits which demonstrate distinctions between the present invention and the art of record. Appellant appeals from the rejection of all pending claims.

This Brief is being filed in triplicate under the provisions of 37 C.F.R. § 1.192. The filing fee set forth in 37 C.F.R. § 1.17(c) of Three Hundred Twenty Dollars ($330.00) is now being submitted. The Commissioner is hereby authorized to charge payment of any additional fees associated with this communication, or to credit any overpayment, to Deposit Account No. 50-2587.

1. REAL PARTY IN INTEREST

The real party in interest is the assignee, International Business Machines Corporation, Armonk, New York.

2. RELATED APPEALS AND INTERFERENCES

There are no related appeals and interferences.

3. STATUS OF CLAIMS

The Examiner objected to the abstract and claim 7. These elements have been amended and the objection withdrawn.

The Final Office Action rejected claims 1-9 under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent Application Publication No. 2002/0024780 to Mao et al. (hereinafter "Mao") in view of U.S. Patent Application Publication No. 2001/0013997 to Sasaki et al. (hereinafter "Sasaki"). The Final Office Action rejected claims 10 and 11 under 35 U.S.C. §103(a) as being unpatentable over Mao in view of Sasaki and further in view of U.S. Patent Application Publication No. 2002/0054463 to Mukoyamma et al. (hereinafter "Mukoyamma"). The Examiner rejected claim 12 under 35 U.S.C. §103(a) as being unpatentable over Mao in view of Sasaki and further in view of U.S. Patent Application Publication No. 2001/0014412 to Jongill et al. (hereinafter "Jongill"). Appellant appeals the rejection of pending claims 1-12.

4. STATUS OF AMENDMENTS

Concurrent with this paper, Appellant is filing a Request for Reconsideration and Amendment. In the Request for Reconsideration and amendment, claims 1-2, 7-8, and 12 have been amended, claims 3-5 have been cancelled, and claims 13-15 have been added to place the application in condition for allowance. A decision from the Examiner regarding entry of these amendments is still pending.

5. SUMMARY OF INVENTION

By way of background, the present invention teaches a spin-valve sensor for use in hard disk read heads. *Specification*, page 4, line 7, page 5, lines 11-21. Specifically, the present invention is with regard to a gap layer that sits between the Giant Magneto Resistance (GMR) and a shield layer. *Id.* This gap layer is made of multiple layers of *in-situ* oxidized metallic films

such as Aluminum (Al). This gap layer serves as an insulation layer. Consequently, the electrical resistance across the gap layer should be maximized. In addition, in order to make the spin-valve sensor as small as possible, it is desirable that the thickness of the gap layer be minimized. The present invention provides for a gap layer of a spin-valve sensor to have optimal resistance to prevent shunting and minimal thickness to reduce the overall size of the spin-valve sensor.

6. ISSUES

The following issues are presented for review:

I. Did the Examiner fail to establish *prima facie* obviousness of claims 1 – 12 where the limitations of the present invention are not found in the cited prior art?

II. Has the Appellant met the burden of proof to establish that the product produced by the prior art is unobviously different from the claimed product formed by a different process?

III. Did the Examiner fail to establish *prima facie* obviousness of claims 3-6 where the cited prior art references teach against forming of layers in a spin valve using *in-situ* processes?

VI. Did the Examiner fail to establish *prima facie* obviousness of claims 1 – 12 where the cited prior art references in combination as a whole, do not motivate or suggest the claimed invention?

V. Did the Examiner fail to establish *prima facie* obviousness of claims 1 – 12 where the teaching to combine the prior art references is only found in the Appellant's disclosure?

VI. Did the Examiner fail to establish *prima facie* obviousness of claims 1 – 12 where obviousness was found by the hindsight combination of components culled from the prior art?

7. GROUPING OF CLAIMS

The Examiner rejected claims 1-9, 10-11, and 12 as separate groups. Claims 1, and 2 stand or fall as a group. Claims 3-6 stand or fall as a group. Claims 7-11 stand or fall as a group. Claim 12 stands or falls individually. Arguments why claim 12 is separately patentable is provided in the "Argument" section below.

8. ARGUMENT

I. <u>Claims 1-11, and 12 are not obvious under 35 U.S.C. § 103 because the Mao reference and the Sasaki reference do not contain all the limitations of the present invention.</u>

The Prior Art. The two main references combined to reject the claims under Section 103 are summarized below.

Mao. Mao discloses a spin valve/GMR sensor and methods of fabricating the same. *Mao* Abstract. Mao focuses on a Mn-based antiferromagnetic pinning layer with a high blocking temperature in contact with a synthetic antiferromagnetic layer. As noted by the Examiner, in the first office action, Mao fails to teach or disclose a gap layer disposed to one side of an antiferromagnetic pinning layer as in the claimed invention.

Thus, the invention taught by Mao discloses conventional layers of a GMR sensor but not the gap layer.

Sasaki. Sasaki discloses a GMR sensor having shield layers and gap layers disposed between the GMR sensor and the shield layers. *Sasaki,* abstract. The gap layer in Sasaki "is made up of a plurality of thin alumina films stacked that are formed by performing the step of forming a thin alumina film by low pressure CVD." *Id.* Each of the alumina films are formed using Chemical Vapor Deposition (CVD). *Sasaki,* paragraph 76. The process of combining chemical vapors to form films such as the gap layer is described in paragraph 101 of Sasaki. In Sasaki, CVD involves forming of alumina films, which is aluminum oxide, by a chemical reaction between two gases that are intermittently injected where one gas may be H_2O, N_2O or H_2O_2; the other may be $Al(CH_3)_3$ or Al_2Cl_3. A metal oxide is formed and deposited at substantially the same time. The gap layer serves to prevent shunting between the GMR sensor and the shield layer. *Sasaki,* paragraph 11. To achieve the desired insulation properties, Sasaki forms a gap layer with a thickness between about 100 and 200 Angstroms. *Sasaki,* paragraph 11, 14.

Prima Facie Obviousness under 35 U.S.C. § 103 The Federal Circuit has held that "the 'subject matter' that must have been obvious to deny patentability under § 103 is the entirety of

the claimed invention," *Panduit Corp. v. Dennison Mfg. Co.*, 810 F.2d 1561, 1576 (Fed. Cir. 1987). In the present case, Mao and Sasaki fail however to disclose the entirety of the claimed invention. Specifically, Mao and Sasaki fail to disclose a gap layer comprising a plurality of oxidized metallic films.

Claim 1.

Mao and Sasaki fail to disclose "...a gap layer disposed to one side of the antiferromagnetic pinning layer, the gap layer comprising a plurality of **oxidized metallic films**." as recited in claim 1 of the present invention. Appellant agrees that Mao fails to disclose gap layers and that Sasaki discloses a gap layer. Appellant understands that the gap layers differ in the manner in which they are made. However, Appellant asserts that the metal oxide taught and disclosed in Sasaki as the gap layer is materially different from the oxidized metallic films of the claimed invention. Specifically, the gap layer of the present invention provides higher electrical resistance, higher insulation properties, than the gap layer of the prior art. Therefore, Appellant asserts that the burden of showing an unobvious difference between the claimed product and the prior art product has been met in accordance with *In re Marosi* 710 F.2d 798, 802, 218 USPQ 289, 292 (Fed. Cir. 1983). This burden has been met by responses and affidavits previously entered on the record, as well as an affidavit and exhibits being submitted with this Appeal Brief.

To understand the difference in the resulting products produced using the claimed invention and the prior art, it may be useful to consider three convention processes and compare these to that of the claimed invention. None of these methods produce a gap layer having electrical resistance as high as with oxidation of a pure, thin metal layer as in the claimed invention. The three methods of forming metal oxide films such as Al_2O_3 films are:

1. Direct Physical Vapor Deposition (PVD) sputter-deposition from an Al_2O_3 target;
2. Reactive PVD sputter-deposition in oxygen gas from an Al target; and
3. Chemical Vapor Deposition (CVD) where two gases are combined, one gas may be H_2O, N_2O or H_2O_2, the other may be $Al(CH_3)_3$ or Al_2Cl_3 the resulting Al_2O_3 is deposited onto a substrate, as in Sasaki;

These three methods share the same difficulty in achieving full oxidation. In other words, stoichiometric Al_2O_3 cannot be attained, thus leaving unwanted, **non-oxidized Al** or other metal

atoms. As a result, the metal oxide films formed with these three methods will not provide the very high resistance needed for very thin gap layers used for ultrahigh-density magnetic recording as in the claimed invention.

The degree to which the metal is oxidized according to the present invention, or any of the above methods is extremely difficult to quantify. However, the degree of oxidation may be derived by understanding the physical characteristics of the metal oxide that results. In method 1, the quality of the gap layer depends on the purity of the Al_2O_3 target. It is difficult to attain a good-quality gap layer since only a low-purity Al_2O_3 target can be fabricated with low-vacuum sintering of low-purity oxide powders.

In method 2, the quality of the gap layer depends on the purity of the Al target and the oxygen doping extent during the reactive sputtering. In spite of the fact that a high-purity Al target can be fabricated with high-vacuum casting of a high-purity Al melt phase, it is still very difficult to attain a good-quality gap layer since the oxygen doping extent cannot be as high as desired. At such a high oxygen doping extent, no oxide can be deposited since the deposition rate is nearly zero.

In method 3 taught by Sasaki, the quality of the gap layer depends on the purity of the gases at an early stage of the CVD process. It is difficult to attain a good-quality gap layer since unwanted Al, H_2O, N_2, H_2,, C or Cl_2 may also be introduced into the oxide layer, and stoichiometric Al_2O_3 cannot be absorbed on a dissimilar surface in the early stage.

In contrast, in the claimed invention, the quality of the gap layer depends on the purity of the Al target and the oxidation extent after the deposition of a very thin Al film which produces "**oxidized** metallic films." It is feasible to attain a high-quality gap layer since a high-purity Al target can be fabricated with high-vacuum casting of a high-purity Al melt phase, and the oxidation extent can be as high as desired. Preferably, oxidation is conducted *in-situ* (exposed to an oxygen-containing atmosphere in-place, without movement). The very thin Al film with a closely packed face-centered-cubic crystalline lattice is first formed. Oxygen atoms are then introduced to fill vacancy sites of the crystalline lattice, and chemically bond to all the Al atoms for full oxidation. It should be noted that excessive oxygen gases can be introduced to ensure that full oxidation is attained.

Full oxidation of the gap layer provides superior insulation properties over partial oxidation which is achieved using the CVD process for forming the gap layer. As mentioned above, quantifying the differences in the oxidation of the gap layer in the claimed invention and the prior art is very difficult. However, the degree of oxidation may be derived by analyzing the physical characteristics of such layers when used in applications (other than as a gap layer) which require the layer to be an optimal insulator (very high electrical resistance).

For example, attempts have been made to use metal oxides for the barrier layer in a TMR (Tunneling Magnetoresistance) sensor. In order for a TMR sensor to work, there must be tunneling effects. To produce tunneling effects, there must be substantially no current flow through the barrier layer and there must be no metal elements in the barrier layer. Only a pure metal oxide will provide for no metal elements and no current flow (very high electrical resistance) such that conduction electrons will be forced to travel only by making quantum jumps ("the tunneling effect").

Attempts to use a barrier layer made of metallic oxide such as Al_2O_3 formed using the CVD process have been made and are explained in the paper entitled "ALCVD AlOx Barrier Layers for Magnetic Tunnel Junction Applications" (referred to herein as "ALCVD paper") by R. Bubber, M. Mao, T. Schneider, H. Hegde, K. Sin, S. Fundada, and S. Shi submitted herewith as exhibit A. This paper indicates that Al_2O_3 metallic oxide formed using CVD as taught by Sasaki fails to provide the high electrical resistance necessary to allow for the tunneling effect. *See* ALCVD paper page 3, left column, first line of first full paragraph, "The low junction resistance and the ohmic *I-V* feature indicate that the corresponding AlO_X x barrier layers are Al-rich, deviating from the stoichiometric Al_2O_3." In fact, Al_2O_3 metallic oxide formed with the three prior-art methods all fail to provide the high electrical resistance necessary to allow for the tunneling effect.

In contrast, a barrier layer formed using a metallic oxide formed using *in-situ* oxidation has been shown to prevent current flow across the layer and substantially eliminate metal elements such that tunneling effects are achieved. The paper entitled "A Tunneling Magnetoresistance Sensor Overlaid with a Longitudinal Bias Stack" (referred to herein as "Tunneling paper") by Tsann Lin, Daniele Mauri, and Philip M. Rice submitted herewith as

exhibit B demonstrates this. Specifically, the barrier layer is made of Al-O and formed by *in-situ* oxidation. *See* Tunneling paper page 346, end of first paragraph and page 347, second sentence, top of right column. The paper demonstrates that a tunneling effect is achieved using a barrier layer of metallic oxide formed by *in-situ* oxidation.

Therefore, because a metal oxide formed using the CVD process as taught in Sasaki fails to allow for tunneling effects when used as a barrier layer in a TMR sensor and metallic oxides formed using the *in-situ* process allow for tunneling effects when used as the same layer, we can derive an understanding of differences between a metal oxide layer formed using the CVD process and one formed using *in-situ* oxidation. Because tunneling effects require substantially no metal elements and no current flow, it is clear that the *in-situ* oxidized metallic layer has a higher resistance than a CVD metal oxide. Similarly, metal oxides formed using methods 1 and 2 above also fail to allow a tunneling effect. Consequently, the *in-situ* oxidized metallic layer is physically different and a superior insulator over metal oxides formed using conventional methods.

It is important to understand that during the deposition phase, the thickness of the metal is controlled so that the metal remains thin enough for the oxygen to fully chemically bond the metal. For example, the metal may be sputtered to no more than about ten Angstroms. *See* Specification page 14, line 13. Of course higher pressure and time of exposure to oxygen may be used to attain higher oxygen density in the metallic film.

Neither Mao nor Sasaki, singly or in combination, teach the entirety of the limitations of the present invention. Specifically, there is no teaching of "**oxidized** metallic films." Because the limitation of oxidized metallic films formed by sputtering and *in-situ* oxidation produces a fully oxidized gap layer having higher insulation properties than the art of record renders the present invention unobvious, Appellant asserts that claim 1 is allowable.

<u>Claims 3-6.</u>

Claim 3 depends from claim 1 and includes the limitation that the oxidized metallic films are "*in-situ* oxidized metallic films." Claims 4-6 also include the limitation that the gap layer of layers within the gap layer comprise *in-situ* oxidized metallic films. Neither Mao nor Sasaki teach *in-situ* oxidation of metallic films that together comprise a gap layer. Sasaki does refer to a

sputtering process. *Sasaki* paragraph 11. However, there are a variety of sputtering processes (*See* Mao paragraph 25) and there is no teaching in Mao or Sasaki of *in-situ* oxidation of metallic films for a gap layer. Appellant asserts that claims 3, and 4-6 are allowable because the specific limitation of "*in-situ*" oxidation is not described by the prior art relied on in the rejection.

<u>Claims 7-11.</u>

Claims 7-11 depend directly or indirectly from claims 1 and 2 and should be allowed for all the same reasons stated above regarding claims 1 and 2. Furthermore, these claims add limitations to one or more of the elements discussed above which are not identically included in Mao and Sasaki. Nor are these elements taught or disclosed in Mukoyamma or Jongill. Appellant asserts that these claims are allowable.

<u>Claim 12.</u>

Claim 12 is directed towards a disk drive system and is therefore patentably distinct. Claim 12 recites a cap layer "formed of partially *in-situ* oxidized metallic film" and first and second gap layer each comprising a plurality of "oxidized metallic films." These limitations are patentable over the prior art of record for substantially the same reasons as those discussed above.

II. <u>Claims 3 and 4-6 are not obvious under 35 U.S.C. § 103 because Appellant has met the burden of proof to establish that the product produced by the prior art is nonobviously different from the claimed product formed by a different process.</u>

<u>Claims 3-6.</u>

Claim 3 depends from claim 1 and includes the limitation that the oxidized metallic films are "*in-situ* oxidized metallic films." Claims 4-6 also include the limitation that the gap layer of layers within the gap layer comprise *in-situ* oxidized metallic films. Neither Mao nor Sasaki teach *in-situ* oxidation of metallic films that together comprise a gap layer. Sasaki does refer to a sputtering process. *Sasaki* paragraph 11. However, there are a variety of sputtering processes (*See* Mao paragraph 25) and there is no teaching in Mao or Sasaki of *in-situ* oxidation of metallic films for a gap layer.

The Examiner correctly asserted that "*in-situ* oxidized" limitation is a product-by-process limitation. *See* first Office Action page 8. In the request for reconsideration and amendment filed herewith the "*in-situ*" limitation was added to claims 1, 2, 7, 8, and 12 in order to clarify the difference between metal oxide and oxidized metal and to advance prosecution. Entry of these amendments is in the discretion of the Examiner.

Appellant asserts that the burden of showing an unobvious difference between the claimed product and the prior art product has been met in accordance with *In re Marosi* 710 F.2d 798, 802, 218 USPQ 289, 292 (Fed. Cir. 1983). In an affidavit from the first named inventor dated September 30, 2003 and a second affidavit dated December 31, 2003 being submitted with this appeal brief, Appellant has established an unobvious difference between the gap layer produced by the prior art and the gap layer comprising "*in-situ* oxidized metallic films" of the claimed invention. Specifically, the gap layer of the present invention provides higher electrical insulation than the gap layer of the prior art. As discussed above, this is proven by the physical characteristics of the metal oxide that results and by the use of a layer formed of the same material and in the same manner to serve as an electrical barrier layer in a TMR sensor. Appellant asserts that claims 3, and 4-6 are allowable because the specific limitation of "*in-situ*" oxidation is not described by the prior art relied on in the rejection.

III. <u>Claims 3-6 are not obvious under 35 U.S.C. § 103 because the prior art teaches against forming layers of a spin valve sensor using *in-situ* processes.</u>

<u>The prior art</u>. The Mao, Sasaki, Mukoyamma, and Jongill references combined to reject the claims under Section 103 are summarized above.

<u>*Prima Facie* Obviousness</u>. The Federal Circuit has held and the MPEP establishes that "a prima facie case of obviousness may [also] be rebutted by showing that the art, ... teaches away from the claimed invention." MPEP §2144.05(III), *In re Geisler*, 116 F.3d 1465, 1471, 43 USPQ2d 1362, 1366 (Fed. Cir. 1997).

<u>Claims 3-6.</u>

Claims 3-6 recite the limitation of *in-situ* oxidization. Appellant finds no teaching or discussion relating to using an *in-situ* process to form a gap layer of a spin valve sensor. Mao

does discuss use of an *in-situ* process to form certain layers of a spin valve sensor. However, there is no teaching to use the process to form a gap layer. In addition, Mao discourages use of *in-situ* processes. In fact, Mao teaches against use of *in-situ* processes including *in-situ* oxidization in the process of fabricating a GMR sensor. *See* Mao, paragraph 33.

IV. Claims 1-12 are not obvious under 35 U.S.C. § 103 because there is no motivation or suggestion to combine the Mao reference with the Sasaki reference.

The prior art. The Mao and Sasaki references combined to reject the claims under Section 103 are summarized above. The other references, Mukoyamma and Jongill are not discussed because major limitations of the claimed invention are missing from Mao and Sasaki. These major limitations are neither taught nor suggested by Mukoyamma or Jongill.

Prima Facie Obviousness. "It is insufficient that the prior art disclosed the components of the patented device, either separately or used in other combinations; there must be some teaching, suggestion, or incentive to make the combination made by the inventor." *Northern Telecom, Inc. v. Datapoint Corp.*, 908 F.2d 931, 934 (Fed. Cir. 1990) See e.g. *Interconnect Planning Corp. v. Feil,* 774 F.2d 1132, 1143, 227 USPQ 543, 551 (Fed.Cir.1985). To establish *prima facie* obviousness, there must be some suggestion or motivation to modify the reference or to combine reference teachings to arrive at the claimed invention. "The teaching or suggestion to make the claimed combination ... must be found in the prior art, not in applicant's disclosure." MPEP 2143, citing *In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991). "The mere fact that references can be combined or modified does not render the resultant combination obvious unless the prior art also suggests the desirability of the combination." See *MPEP 2143.01*, citing *In re Mills*, 916 F.2d 680, 16 USPQ2d 1430 (Fed. Cir. 1990).

Appellant has argued above that Mao does not contain a gap layer, and that Sasaki does not teach a gap layer having the same electrical resistance properties as the claimed invention. However, even if Sasaki did teach a gap layer having the same electrical resistance properties as the claimed invention, Appellant finds no motivation **in** Mao or Sasaki to combine Mao and Sasaki or the desirability of such a combination to arrive at the present invention. The cited Mao and Sasaki references teach isolated claim limitations similar to the present invention, but fail to

disclose, suggest, or motivate modifying the Mao sensor to arrive at the present invention ***as a whole***.

Prima facie obviousness requires that the prior art teach or suggest the whole invention as claimed. As the Federal Circuit has explained, "It is impermissible within the framework of section 103 to pick and choose from any one reference only so much of it as will support a given position to the exclusion of other parts necessary to the full appreciation of what such reference fairly suggests to one skilled in the art." *Bausch & Lomb, Inc. v. Barnes-Hind/Hydrocurve, Inc.*, 796 F.2d 443, 448, 230 USPQ 416 (Fed. Cir. 1986) (quoting *In re Wesslau*, 353 F.2d 238, 241, 147 USPQ 391, 393 (CCPA 1965)). The burden is on the Examiner to provide the suggestion or teaching of combining the prior art references. *Ex parte Clapp*, 227 USPQ 972, 973 (Bd. Pat. App. & Inter. 1985).

<u>Claim 1.</u>

The Examiner rejected claim 1 by picking and choosing isolated teachings from the Mao and Sasaki references and pasting them together to recreate the claims. Mao teaches various layers of a spin valve/GMR sensor. *Mao*, Abstract. Sasaki discloses a GMR sensor having a gap layer formed from metal oxide rather that oxidized metal. Mao and Sasaki neither suggest nor teach the combination of the present invention, a sin-valve sensor comprising a gap layer comprised of oxidized metallic films. Because the Examiner has shown no motivation or suggestion to combine the prior art references relied on in the rejection or the desirability of such a combination, Appellant asserts that claim 1 is allowable.

<u>Claims 2-12.</u>

As to claims 2-12, these claims depend directly or indirectly from claim 1. As the Examiner has shown no motivation or suggestion to combine the references of Mao and Sasaki, under the rationale discussed above, Appellant asserts that these claims are allowable.

V. <u>Claims 1-12 are not obvious under 35 U.S.C. § 103 because the teaching to combine the prior art references is only found in the Appellant's disclosure.</u>

<u>The prior art</u>. The Mao and Sasaki references combined to reject the claims under Section 103 are summarized above.

Prima Facie Obviousness. For the present invention to be obvious, the suggestion to make the invention's combination must be found in the prior art. *In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991). It is "impermissible to use the claims as a frame and the prior art references as a mosaic to piece together a facsimile of the claimed invention." *Uniroyal v. Rudkin-Wiley*, 5 USPQ2d 1434, 1438 (Fed. Cir. 1988) (citing *W. L. Gore & Associates v. Garlock, Inc.*, 220 USPQ 303, 312). Yet, that is what the final rejection did, citing references with many of the elements of the present invention but lacking all limitations of the present invention or any suggestion or teaching for the combination.

Claim 1.

Appellant respectfully asserts that the teaching or suggestion to make the claimed combination is only found in the Appellant's disclosure. Neither Mao nor Sasaki teach a spin-valve sensor comprising a gap layer comprised of oxidized metallic films. The present invention provides the only suggestion for using oxidized metallic films as a gap layer. Appellant asserts that claim 1 is allowable because the teaching to combine the elements of the present invention is only found in the present invention and not in the prior art relied on in the rejection.

Claims 3-6.

Claims 3-6 depends from claim 1 and should be allowed for all the same reasons stated above regarding claim 1. Because there is no teaching in Mao or Sasaki to combine the prior art references to provide a spin-valve sensor having a gap layer formed from *in-situ* oxidized metallic films, Appellant asserts that claims 3-6 are allowable.

Claims 7-11.

As to claims 7-11, these claims depend directly or indirectly from claims 1. Appellant asserts that these claims are allowable as only the present invention teaches to combine the prior art references in the present invention.

Claim 12.

Claim 12 includes a first gap layer and a second gap layer each made from oxidized metallic films as discussed above.

VI. Claims 1-12 are not obvious under 35 U.S.C. § 103 because obviousness was found by the hindsight combination of components culled from prior art.

The prior art. The Mao, Sasaki, Mukoyamma, and Jongill references combined to reject the claims under Section 103 are summarized above.

Prima Facie Obviousness. The Federal Circuit has held that obviousness cannot be determined by the hindsight combination of components culled from the prior art. *ATD Corporation v. Lydall, Inc.*, 48 USPQ 2d 1321, 1329 (Fed. Cir. 1998).

Claim 1.

Even if Sasaki did teach oxidized metallic films, the suggestion to combine the spin-valve sensor of Mao with the gap layer taught in Sasaki is the result of hindsight. The Examiner has provided no evidence within the references as two why such a combination would be made. Absent a teaching or suggestion to combine Mao and Sasaki, obviousness cannot be established. *ACS Hosp. Sys., Inc. v. Montefiore Hosp.*, 221 USPQ 929, 932, 933 (Fed. Cir. 1984). Appellant asserts that claim 1 is allowable.

Claims 3-6.

Claims 3-6 recite the limitation of *in-situ* oxidization. Appellant finds not motivation to combine these references and form the gap layer using *in-situ* oxidization of a metal film. In fact, Mao teaches against use of *in-situ* oxidization in the process of fabricating a GMR sensor. *See* Mao, paragraph 33.

Claims 2, 7-11 and 12.

As to claims 2, 7-11, and 22, these claims depend directly or indirectly from claim 1 and were also constructed by the hindsight combination of prior art elements. Furthermore, these claims add limitations to one or more of the elements discussed above which are not identically included in Mao and Sasaki. Therefore, under the rationale discussed above, Appellant asserts that these claims are allowable.

No Prima Facie Obviousness Established.

In view of the foregoing, the Examiner has not properly established *prima facie* obviousness of claims 1-12. Appellant respectfully requests reversal of the Section 103 rejection

and allowance of claims 1-12. Appellant submits that the foregoing arguments further establish the non-obviousness of the present invention. Reversal of the rejections and allowance of the pending claims is respectfully requested.

SUMMARY

In view of the foregoing, each of the claims on appeal has been improperly rejected. Reversal of the Examiner's rejection and allowance of the pending claims 1-12 is respectfully requested.

Respectfully submitted,

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9. APPENDIX

Claims involved in the appeal

1. (Original) A spin-valve sensor disposed between gap layers, comprising:

an antiferromagnetic pinning layer;

a pinned layer disposed to one side of the antiferromagnetic pinning layer;

a sensing layer;

a spacer layer disposed between the pinned layer and the sensing layer; and

a gap layer disposed to one side of the antiferromagnetic pinning layer, the gap layer comprising a plurality of oxidized metallic films.

2. (Original) The spin-valve sensor of claim 1, wherein the gap layer comprises a first gap layer disposed to one side of the antiferromagnetic pinning layer and further comprising a second gap layer disposed to one side of the sensing layer; the first and second gap layers comprising a plurality of oxidized metallic films.

3. (Original) The spin-valve sensor of claim 1, wherein the gap layer is formed of a plurality of *in-situ* oxidized metallic films.

4. (Original) The spin-valve sensor of claim 2, wherein at least one of the first gap layer and the second gap layer is formed of an *in*-situ oxidized metallic film.

5. (Original) The spin-valve sensor of claim 2, wherein the first gap layer and the second gap layer are each formed of a plurality of *in-situ* oxidized metallic films.

6. (Original) The spin-valve sensor of claim 2, wherein the first gap layer and the second gap layer are each formed of a plurality of *in-situ* oxidized Al metallic films.

7. (Previously Amended) The spin-valve sensor of claim 2, wherein the plurality of oxidized metallic films has a cumulative thickness in a range of between about 50 Å and about 200 Å.

8. (Previously Amended) The spin-valve sensor of claim 2, wherein the plurality of oxidized metallic films has a cumulative thickness in a range of between about 75 Å and about 150 Å.

9. (Original): The spin-valve sensor of claim 2, wherein each of the plurality of films has a cumulative thickness of about 100 Å.

10. (Previously Amended) The spin-valve sensor of claim 1, further comprising a plurality of seed layers disposed to one side of the antiferromagnetic pinning layer; the seed layers comprising an Al_2O_3 film, a Ni-Cr-Fe film and a Ni-Fe film; the antiferromagnetic pinning layer formed of a Pt-Mn film; the pinned layers formed of a Co-Fe film, Ru film, and a Co-Fe film; the spacer layer formed of an oxygen-doped, *in-situ* oxidized Cu film; the sensing layer formed of a Co-Fe film and a Ni-Fe film, and a cap layer formed of an *in-situ* oxidized metallic film.

11. (Original) The spin-valve sensor of claim 10, further comprising a partially oxidized cap layer adjacent to the sensing layer.

12. (Previously Amended) A disk drive system comprising:

a magnetic recording disk;

a spin-valve sensor for reading data recorded on the magnetic recording disk, the spin-valve sensor comprising:

an antiferromagnetic pinning layer;

pinned layers formed disposed to one side of the antiferromagnetic pinning layer, the magnetizations of the pinned layers substantially fixed by the antiferromagnetic pinning layer;

a sensing layer formed of ferromagnetic films adjacent to the pinned layers, the sensing layers configured to have an electrical resistance that changes in response to changes in magnetic flux through the sensing layer;

a cap layer disposed to one side of the sensing layers, the cap layer formed of a partially *in-situ* oxidized metallic film having a thickness in a range of between about 5 and about 15 Å;

a first gap layer disposed to one side of the antiferromagnetic pinning layer, the first gap layer comprising a plurality of oxidized metallic films;

a second gap layer disposed to one side of the cap layer, the second gap layer comprising a plurality of oxidized metallic films;

an actuator for moving a read/write head comprising the spin-valve sensor across the magnetic recording disk in order for the spin-valve sensor to access different magnetically recorded data on the magnetic recording disk; and

a detector electrically coupled to the spin-valve sensor and configured to detect changes in resistance of the spin-valve sensor caused by rotation of the magnetization of the sensing layers relative to the fixed magnetizations of the pinned layers in response to changing magnetic fields induced by the magnetically recorded data.